FOREST RESEARCH NOTE

1985 No. 39

A comparison between red pine seedlings and transplants five years after outplanting

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Over the years the field performance of seedlings and transplants has received considerable attention (Mullin and Howard 1973, Mullin and Christl 1982). In general, the survival and growth of transplant stock has been better than that of seedling stock. However, nursery cultural practices change and new stock types[1] are periodically introduced. Therefore, it is necessary to field test stock types regularly to determine if shifts in overall field performance occur.

In this study, four red pine (Pinus resinosa Ait.), stock types 3+0, 2+1, 2+2 and the then new 1+2 were tested. The first year results of this experiment were discussed earlier (Glerum et al. 1979). The fifth year survival and height growth of these stock types are compared.

Procedures

Four red pine stock types from two nurseries (Orono and Midhurst) were tested: 3+0, 2+2, 1+2 and 2+1. The 2+1 stock type was only available at Orono. All stock types were planted during the spring of 1978 at Vivian forest (Lat.N. 44°03', Long. 79°18') and at Larose forest (Lat.N. 45°25', Long. 75°01'). The sites were abandoned farm fields of fine to medium sand with heavy grass cover, and were shallowly furrowed prior to planting. The trees were planted in a randomized block design with 5 replications of 100 trees/stock type/nursery at each location.

Total height and annual increment of each tree was measured at the end of the first, second, third and fifth growing season. Survival percentages, after arc-sin transformation, and the height data were subjected to analyses of variance. An analysis of covariance was conducted on the Vivian height data only, using initial height as the covariate. The Larose data were not subjected to such an analysis because of the confounding effects of frost and mice damage. All comparisons between treatments were made, using Duncan's new multiple range test.

Results and Discussion

Significant differences in survival occurred ($P<0.01$) between stock types at both locations but the differences were more pronounced in the Orono stock than in the Midhurst stock (Table 1). Differences between first and fifth year survival were small at Vivian but were large at Larose, due to heavy frost damage in the third

[1] We prefer to use the phrase "stock type" instead of "age-class", because many of our stock types are the same age, e.g. 3+0, 1+2 and 1.5+1.5 but in particular when dealing with accelerated transplants (also called greenhouse transplants), e.g. 4G+1, 4G+1.5, etc.

Further information may be obtained from:

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TABLE 1 Average first and fifth year survival (in percent) of several red pine stock types from two nurseries planted at two locations*

Stock type	Vivian Forest				Larose Forest			
	Orono		Midhurst		Orono		Midhurst	
	1st yr	5th yr	1st yr	5th yr	1st yr	5th yr	1st yr	5th yr
1+2	92a	89a	95a	93a	95a	58a	100a	66a
2+2	83b	80b	94a	89a	85b	60a	99a	73a
2+1	76c	72b	-	-	84b	52a	-	-
3+0	71d	67c	93a	91a	79c	38b	94b	30b

* Survival figures in the columns not followed by the same letter, differ significantly from each other at the 1.0% level.

year, followed by heavy mouse damage in the fourth and fifth years. In three of the four comparisons the transplant survival was significantly better than seedling survival.

Total heights between stock types differed significantly ($P<0.01$) at both locations with the 2+2 stock type being greatest and the 2+1 stock type being smallest (Figs. 1 and 2). In three comparisons, the height of the 1+2 stock type was greater than that of the 3+0 stock type, and in one comparison (Fig. 2) there was no significant difference in their height.

The analysis of covariance showed that initial height at time of planting was highly correlated with fifth year height. Therefore, the effect of initial height was removed from fifth year height through covariance analysis, which changed the

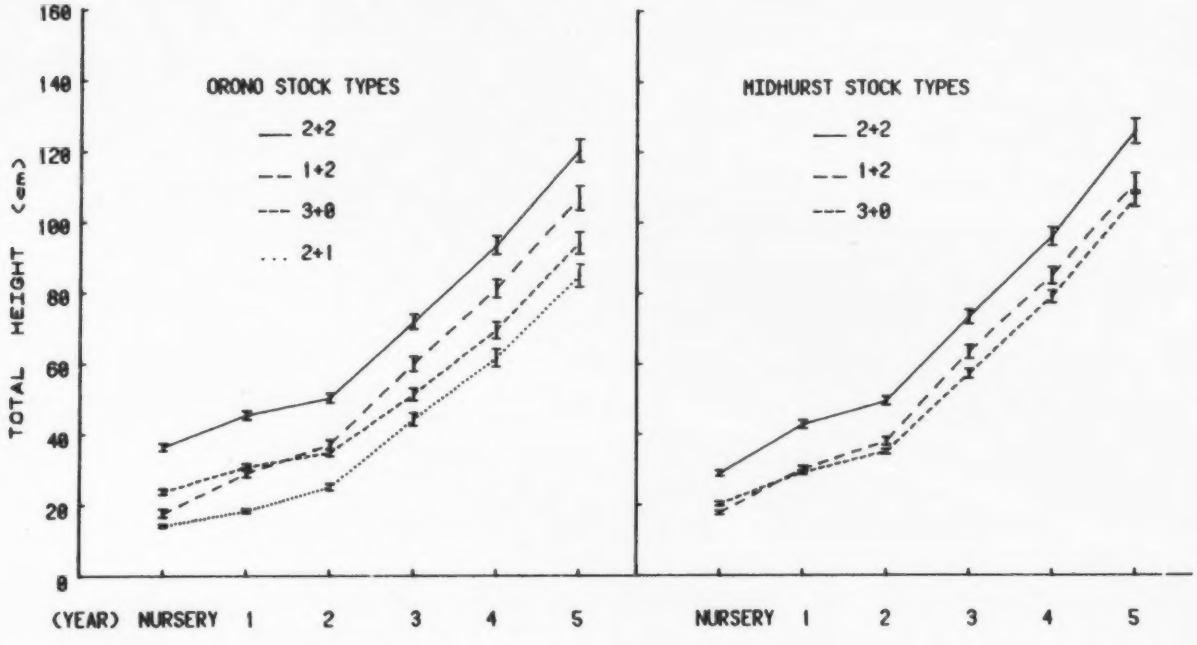

Fig. 1 Cumulative five-year average height growth after outplanting of several red pine stock types from Orono and Midhurst nurseries at Vivian forest. Vertical bars are 99% confidence limits.

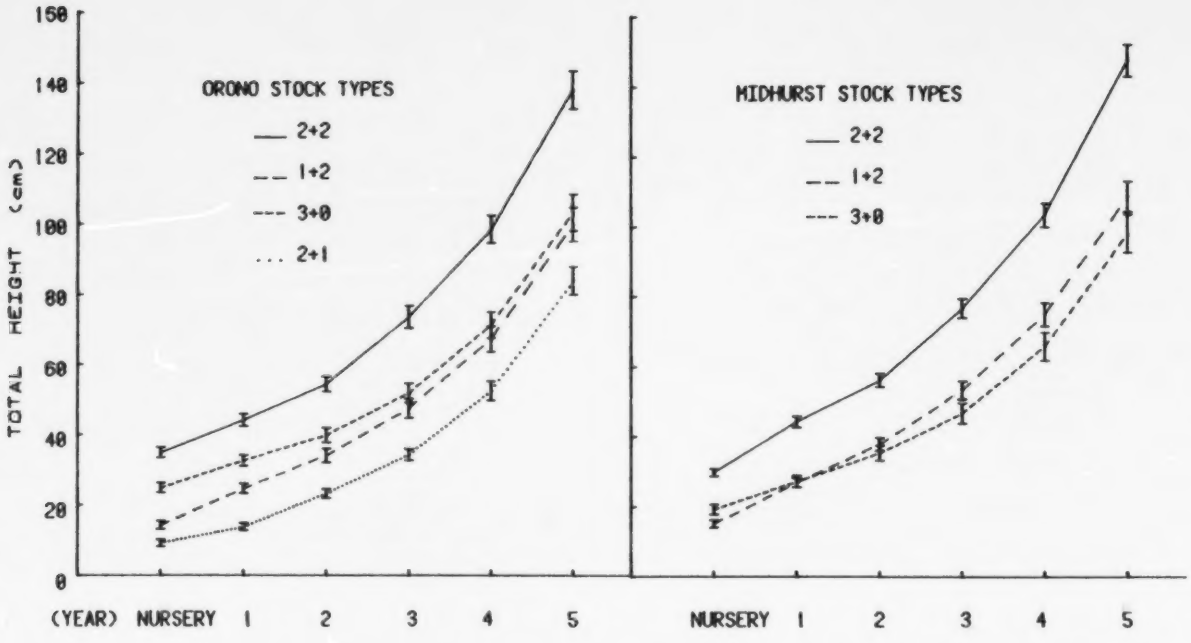

Fig. 2 Cumulative five-year average height growth after outplanting of several red pine stock types from Orono and Midhurst nurseries at Larose forest. Vertical bars are 99% confidence limits.

ranking of the stock types considerably (Table 2). When the unadjusted fifth year heights were ranked, the 2+2 stock type was best followed in descending order by the 1+2, 3+0 and 2+1 stock types; however with the adjusted heights the 1+2 stock type was the fastest growing. The most notable change in ranking occurred in the Orono 2+2 stock type, which dropped from an unadjusted height ranking of 2 to an adjusted height ranking of 6.

Racey and Hutchison (1984) also found that the growth rate of 1+2 red pine was significantly greater than that of 3+0 red pine, but that of 2+0 red pine was greater than that of the 1+2 red pine. However, their planting was on a sandy site with minimum competition. We did not include the 2+0 stock type in our comparisons because it was unavailable at time of planting and furthermore 2+0 red pine will only do well when competition is kept to a minimum.

TABLE 2 Ranking of several red pine stock types by fifth-year average height and fifth-year average height adjusted for initial height using an analysis of covariance*. Stock is from two nurseries and planted at Vivian Forest.

Stock type	Average 5th year Height (cm)	Ranking	Adjusted average 5th year height (cm)	Ranking
1+2 Orono	106.9a	4	114.7a	3
1+2 Midhurst	111.4a	3	118.9a	1
2+2 Orono	120.4b	2	98.9b	6
2+2 Midhurst	126.2b	1	116.1a	2
2+1 Orono	84.9c	7	99.6b	5
3+0 Orono	94.2c	6	92.5c	7
3+0 Midhurst	106.9a	5	110.0a	4

* Height figures in the columns not followed by the same letter, differ significantly from each other at the 1.0% level.

TABLE 3 Aggregated height (m) 5 years after outplanting of several red pine stock types from two nurseries at two locations. (Aggregate height m/100 trees planted.)

Stock type	Vivian Forest		Larose Forest	
	Orono	Midhurst	Orono	Midhurst
1+2	95.2	103.2	56.8	71.9
2+2	96.0	112.1	82.8	108.0
2+1	61.2	-	43.7	-
3+0	63.0	97.4	38.0	31.2

When evaluating stock-type performance both survival and subsequent growth should be taken into consideration, which can be done by combining survival and growth in the form of aggregate height (Table 3). At both locations the 2+2 and 1+2 stock types performed better than the 3+0.

The effects of planting shock were evident in the first two years after outplanting when height growth was small in comparison to the height increases that occurred in the third to fifth year (Figs. 1 and 2). This relatively slow initial height growth is typical for red pine during the plantation establishment phase, because during the first two years after outplanting the stresses associated with planting, reduce root growth and bud development. During the third growing season the normal pattern of growth is re-established. The severity of these stresses are also influenced by site. On a good site, such as Larose (Fig. 2), the stresses are less pronounced than on a somewhat poorer site, such as Vivian (Fig. 1).

In this experiment the field performance of red pine from Midhurst was better than that from Orono and is probably due to differences in planting stock quality, which can be expected to vary from one year to the next.

The selection of stock type for planting depends on a combination of factors such as site, degree of site preparation, amount of tending and planting stock quality. The 1+2 stock type, which was new to Ontario at time of planting in our experiment, appears to be a viable alternative to the 2+2 stock type, because it is cheaper to grow, is more compact, is easier to handle and plant, while it still performs well.

Literature Cited

GLERUM, C., J.G. BOUFFORD and J.M. PATERSON. 1979. Irregular growth of outplanted red pine. V. A comparison between seedling and transplant stock. Ont. Min. Natur. Resour., For. Res. Note No. 23. 4 p.

MULLIN, R.E. and C.P. HOWARD. 1973. Transplants do better than seedlings and ... For. Chron. 49 (5): 213-218.

MULLIN, R.E. and C. CHRISTL. 1982. Morphological grading of white pine nursery stock. For Chron. 58 (1): 40-43.

RACEY, G.D. and R.E. HUTCHISON. 1984. A field test of 3 red pine age classes. Ont. Min. Nat. Resour. Nursery Note No. 106. 5 p.

MNR: 3361
(.8K P.R., 85 06 12)
ISSN: 0381-2650